Plasma Processes, Inc.

Development of Tantalum Carbide for Microgravity Containment Cartridges

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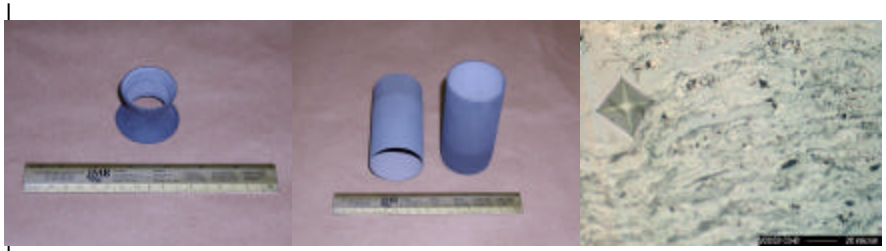
Description and Objectives

- Refractory metal cartridges have limited resistance to attack from molten aluminum.
- These materials have relatively low emissivities which result in reduced rates of heat transfer from the heater core to samples being processed.
- Tantalum carbide (TaC) has been identified as having a high resistance to attack by molten aluminum as well as having a significantly higher emissivity than typical refractory metal cartridge materials.
- The overall objective is to develop methods for producing TaC on the internal and external surfaces of containment cartridges for use in microgravity furnaces.



A B C

A – VPS formed TaC rocket nozzle produced by PPI.
B – VPS formed TaC open ended cylinders produced by PPI.
C – Photomicrograph of TaC deposit showing high density. Vickers microhardness measurements have varied between 760-810 VH. Note the absence of cracks at the indentation corners.

Approach

- During Phase I, two methods will be evaluated for producing TaC for use with SACAs. The two methods are Vacuum Plasma Spray (VPS) forming and Plasma Assisted Carburization (PAC).
- The initial effort will focus on verifying the chemical compatibility of the tantalum carbide deposits produced from each method with molten aluminum.
- Tests will also be performed to determine high temperature emissivity values.
- The development and fabrication of closed-end tubes with TaC on the OD and ID will be undertaken in the Phase II.

Subcontractor None

Schedule and Deliverables

- 6 months for development of the processes, fabrication of test articles, and characterization.
- Techniques for producing TaC for microgravity applications
- Experimental compatibility data for TaC with molten Al
- High temperature emissivity values for TaC

NASA and Commercial Applications

- Increased protection for ISS hardware/crew
- Improved experimental results
- Rocket motors, heat pipes, power generation, electronics